Feb. 2, 1954 H. H. RUMPEL 2,668,015

ADJUSTMENT STRUCTURE FOR CONCAVES OF GYRATORY CRUSHERS

Filed May 2, 1952 2 Sheets-Sheet 1

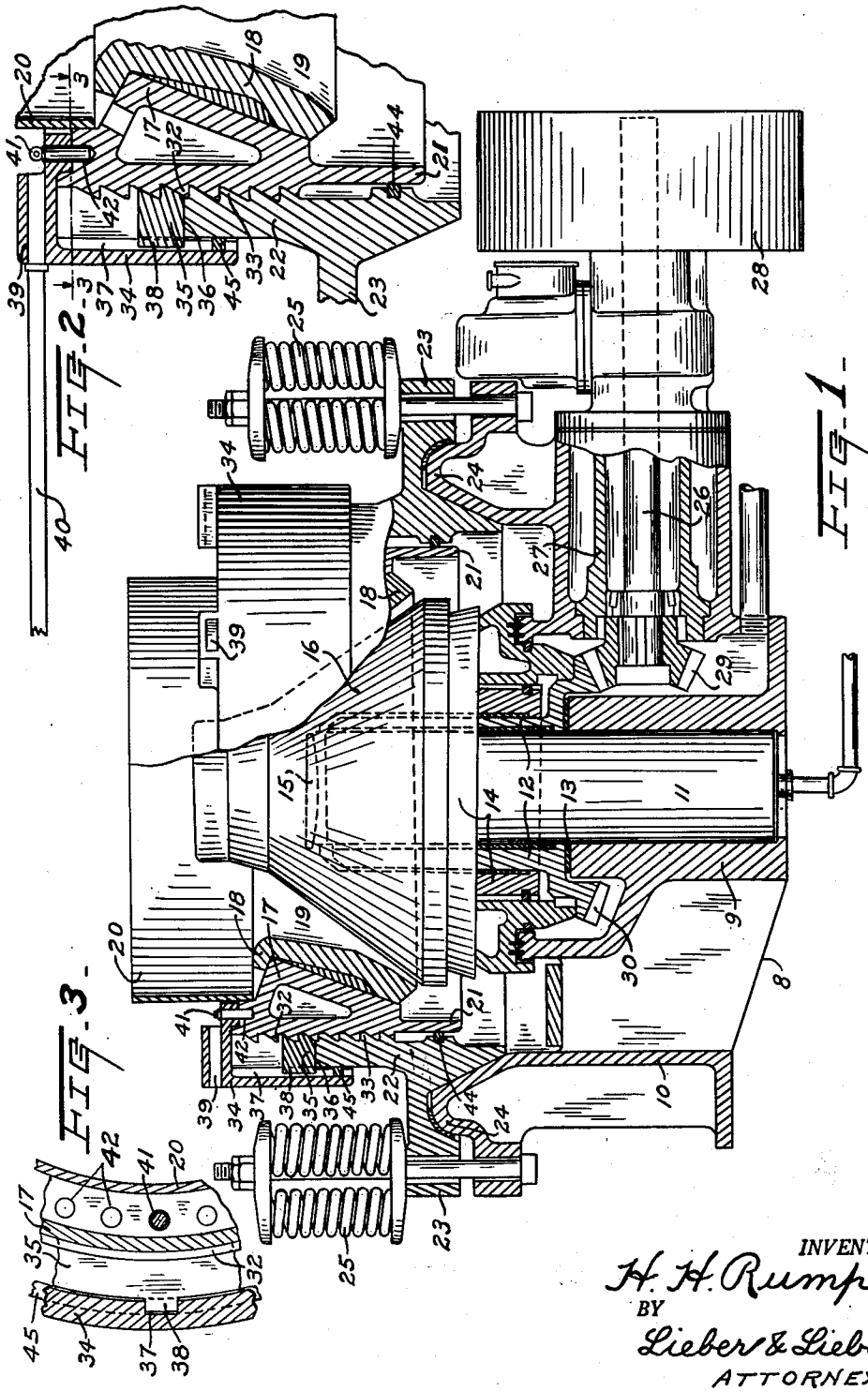


FIG. 1

FIG. 2

FIG. 3

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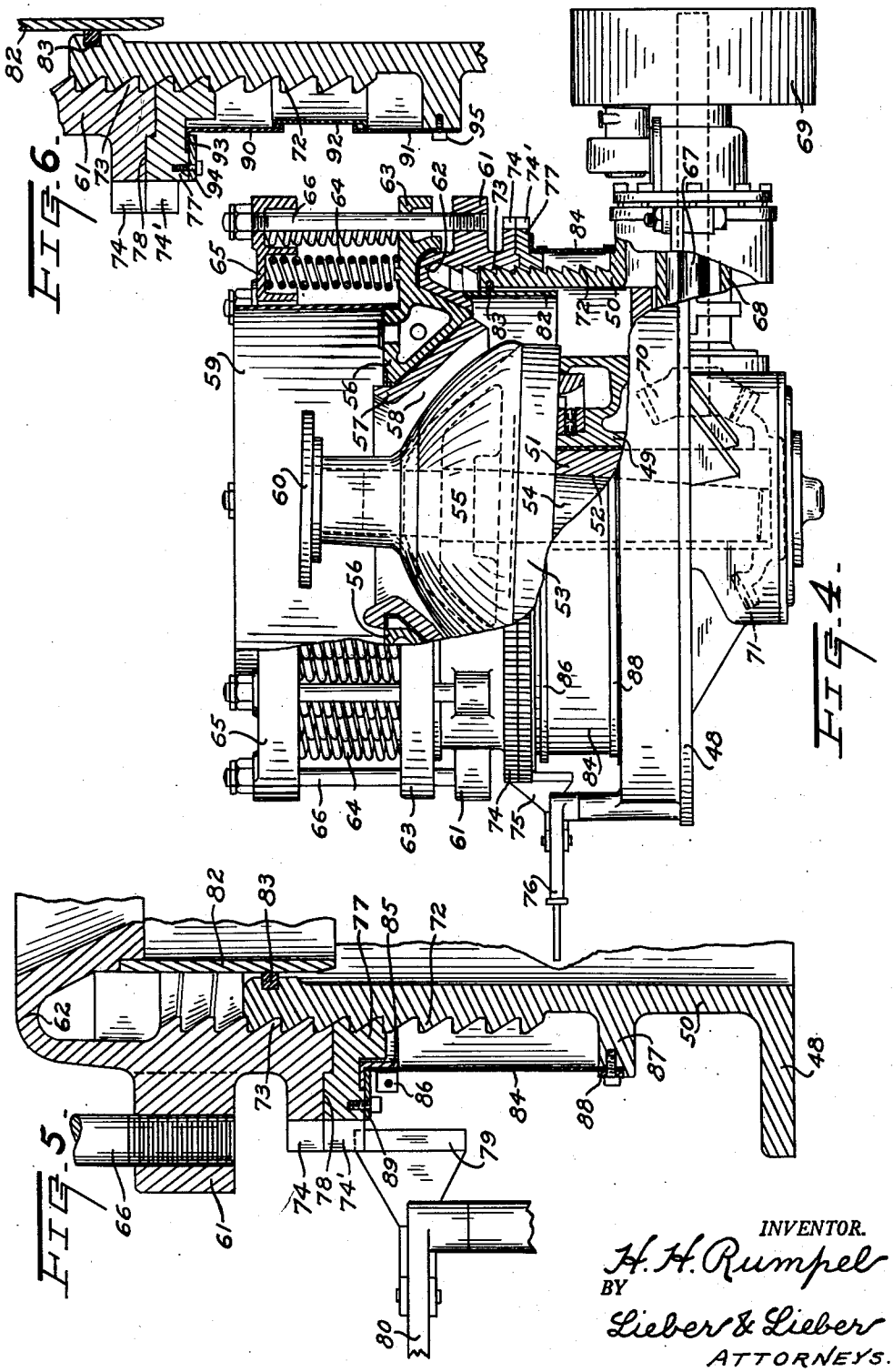


FIG. 6.

FIG. 4.

FIG. 5.

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ADJUSTMENT STRUCTURE FOR CONCAVES OF GYRATORY CRUSHERS

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4 Claims. (Cl. 241—207)

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The present invention relates in general to improvements in gyratory crushers for rock, ore and similar substances, and relates more particularly to improvements in the construction and operation of the mechanism for effecting adjustment of the concave crushing member relative to the crushing head member of a gyratory crusher in order to produce uniform final crushed product.

The primary object of my present invention is to provide simplified and dependable mechanism for effecting relative adjustment of the normally fixed and gyratable crushing members of a gyratory crusher and for protectively maintaining the same in various positions of adjustment.

In gyratory crushers which are used to reduce rock, ore, and other hard substances, to relatively small and uniform size, it is extremely desirable for the operator to be able to rapidly adjust the crushing members relative to each other and to positively maintain them in relatively adjusted position, in order to compensate for wear and to vary the size of the final product at will. Since the crushing head of this type of crusher is normally gyrating while the crushing concave is normally fixed, it is easier to effect relative adjustment of these coacting crushing members by moving the concave toward or away from the head as with the aid of screw threads interposed between the concave member and the crusher frame. After each such adjustment has been effected, it is also necessary to positively hold the concave in adjusted position in order to insure the production of uniform final product, and such holding of the concave member has heretofore been universally accomplished by wedging the coacting adjusting threads against each other with the aid of a number of individually manipulable jack screws coacting either directly with one of the threaded parts or with segmental wedges cooperating with the adjusting threads. This mode of effecting concave adjustment is not only tedious, complicated and difficult to accomplish due to the use of numerous individually operable jack screws, but it is also impossible to effectively seal the adjusting threads and the screw threads of the jacks from exposure to the dusty surroundings in which these crushers normally operate, and none of the prior adjusting mechanisms have been properly sealed to so seal and protect them.

It is therefore an important object of the present invention to provide improved means for not only effecting relative adjustment of the concave and head of a gyratory crusher, but for also holding these parts in various positions of adjustment and for sealing the adjusting mechanism against all possible ingress of foreign matter.

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Another important object of my invention is to provide improved adjusting and sealing mechanism for the crushing members of a recrusher, wherein adjustments may be quickly and accurately effected without exposing the adjusting threads to dust and grit and with minimum loss of time.

A further important object of this invention is to provide an improved screw thread adjustment for the concave crushing member or bowl of a gyratory crusher, wherein only one element need be manipulated in order to effect accurate adjustment and to insure firm subsequent clamping of the adjusted element.

Still another object of the invention is to provide a simple, durable, and reliable adjusting device applicable to various types of gyratory fine crushers, at moderate cost and so as to insure production of uniform final product of any desired size.

These and other more specific objects and advantages of the present invention will be apparent from the following detailed description from which it will be apparent that the gist of my invention is the provision of a constantly and thoroughly sealed and protected and easily manipulable adjusting and holding mechanism for the concave crushing member or bowl of a gyratory crusher.

A clear conception of the features constituting the present improvement, and of the construction and operation of the improved adjusting and sealing devices as applied to several types of gyratory crushers, may be had by referring to the drawings accompanying and forming a part of this specification and wherein like reference characters designate the same or similar parts in the various views.

Fig. 1 is a part sectional side elevation of one kind of commercial gyratory crusher having one type of the improved concave crushing member adjusting and sealing mechanism applied thereto, the section having been taken vertically and centrally through the crushing chamber;

Fig. 2 is an enlarged fragmentary radial section similar to that of Fig. 1, but showing the details of construction of the adjusting and sealing mechanism more clearly;

Fig. 3 is a likewise enlarged fragmentary horizontal section taken through the mechanism of Fig. 2 along the line 3—3;

Fig. 4 is a part sectional side elevation of another kind of commercial gyratory crusher having a similar type of the improved concave crushing member adjusting and sealing mechanism applied thereto, the section again having been taken vertically and centrally through the crushing chamber;

Fig. 5 is an enlarged vertical radial section through the modified concave bowl adjusting and sealing mechanism of Fig. 4, showing a flexible tubular external seal; and

Fig. 6 is a fragmentary likewise enlarged vertical radial section through a further modified concave bowl adjusting and sealing mechanism somewhat similar to that of Figs. 4 and 5 but having a telescopic external seal applied to the adjusting device.

While the invention has only been illustrated and described as being advantageously applicable to two kinds of typical gyratory crushers, it is not the intention to unnecessarily limit the use of the improvement to these specific crushers; and it is also contemplated that the descriptive terms used herein be given the broadest possible interpretation consistent with the disclosure.

Referring especially to Figs. 1, 2 and 3 of the drawings, the high speed gyratory crusher shown therein, comprises in general, a durable main frame 8 having a central hub 9 and an annular outer wall 10 spaced from but rigidly secured to the hub; an upright cylindrical column 11 fixedly mounted within the frame hub 9; an eccentric sleeve 12 having a central bore journalled for rotation about the fixed column 11 and resting upon a thrust bearing 13 at the upper end of the hub 9; an inner crushing member or head 14 freely rotatable about and gyratable by the external eccentric surface of the sleeve 12 and resting upon a floating thrust bearing 15 at the upper extremity of the column 11, the head 14 being provided with a frusto-conical crushing mantle 16; a normally fixed annular outer crushing member or concave 17 surrounding the head 14 and having therein a tapered crushing liner 18 cooperating with the mantle 16 to form an annular downwardly extending and outwardly flaring crushing chamber 19; a coarse material supply hopper 20 carried by the concave 17 in open communication with the upper inlet end of the chamber 18; an annular inner apron 21 suspended from the bottom of the concave 17 around the lower outlet end of the chamber 19; a concave support or ring 22 having an annular lower flange 23 tiltably mounted upon a ridge 24 formed integral with the upper end of the frame wall 10 and being normally held in firm contact with the ridge 24 by a series of heavy springs 25; and a power shaft 26 journalled in a tubular casing 27 mounted in the lower portion of the frame 8 and having a driving pulley 28 at one end thereof while its opposite end is provided with a bevel pinion 29 meshing with a bevel gear 30 rigidly associated with the lower end of the eccentric sleeve 12.

All of the foregoing crusher structure is relatively well known, and since the opposed crushing surfaces of the head mantle 16 and bowl or concave liner 18 are obviously subjected to considerable wear, these elements are readily removable from their carrying element for renewal; and since these crushing surfaces also gauge the size of the final product they must be capable of convenient relative adjustment either due to excessive wear or in order to vary the desired size of the crushed material. In the crusher of Figs. 1, 2 and 3, such adjustment is made possible by providing external screw threads 32 on the periphery of the concave member 17 and coacting with internal screw threads 33 formed within the supporting ring 22, and by also providing an adjusting outer apron or collar 34 surrounding and cooperating with a clamping ring nut 35 having internal screw threads coacting with the threads 32 of the concave and also having a plane lower face 36 cooperable with the extreme upper flat end surface of the ring 22. The adjusting collar 34 preferably has several internal parallel recesses 37 formed therein while the ring nut 35 is provided with equally spaced integral external peripheral projections or keys 38 which are slidably engageable with the adjacent recesses 37, and the upper end of the collar 34 is also provided with a series of equally spaced radial openings 39 adapted for the reception of a lever or turning bar 40 and with an opening for receiving one or more readily removable pins 41. The pins 41 are cooperable with any one or more of a series of spaced holes 42 formed in the top of the concave member 17 while and after adjustment of the concave 17 is being or has been effected and during normal operation of the crusher.

Since these crushers are usually subjected both internally and externally to dusty and gritty surroundings, it is important that the adjusting screw threads 32, 33 and the lock nut 35 be thoroughly concealed and protected against foreign substances, at all times. In the crusher of Figs. 1, 2 and 3, such concealment and protection is afforded by providing a resilient sealing ring 44 between the concave supporting ring 22 and the concave apron 21 on the inner side of the adjusting threads, and by providing another resilient sealing ring 45 between the adjusting collar 34 and the supporting ring 22 on the outside of these threads. The rings 44, 45 are preferably formed of felt, and the inner sealing ring 44 is confined within an annular groove formed in the concave support 22 and slidably cooperates with the outer cylindrical surface of the apron 21 to constantly seal the adjusting threads against entry of foreign matter from the crushing chamber 19, while the outer sealing ring 45 is confined within an annular groove formed in the adjusting collar 34 and slidably cooperates with the outer cylindrical surface of the concave support 22 to likewise constantly seal the screw threads against entry of foreign substances from the ambient atmosphere. These sealing rings 44, 45 also maintain the clamping nut 38 and the guide recesses 37 and keys 38 constantly confined and protected.

During normal operation of the crusher illustrated in Figs. 1, 2 and 3, power may be applied from any suitable source to the pulley 28 and shaft 26, thereby transmitting rotary motion through the pinion 29 and gear 30 to the eccentric sleeve 12 and causing the latter to revolve about the fixed column 11 and upon the lower thrust bearing 13 and to thereby gyrate the inner crushing member or head 14 relative to the outer crushing member or concave 17 while permitting free rotation of the head 14 and its mantle 16 about the eccentric and upon the upper thrust bearing 15. The material to be crushed may then be deposited within the hopper 20 from which it gravitates into the crushing zone or chamber 19, and as this material advances downwardly through the chamber 19 it is gradually crushed between the head mantle 16 and

concave liner 18 and is eventually delivered through the annular outlet opening at the lower end of the crushing zone and falls through the space between the frame hub 9 and wall 10. If for any reason uncrushable material is admitted to the crushing zone or chamber 19, the springs 25 will immediately permit the concave 17 and its support 22 to tilt and to thereby allow the obstructing material to pass through the crusher without danger of breaking overstressed parts, but the concave member 17 normally assumes a fixed position unless some adjustment thereof becomes necessary.

If such adjustment in fact becomes desirable, either due to excessive wear on the crushing surfaces of the mantle 16 and liner 18 or in order to vary the size of the final product, the retainer pins 41 must first be withdrawn so as to release the collar 34 whereupon the latter may be rotated slightly with the aid of a bar or bars 40 applied to one or more of the socket openings 39, sufficient to release the annular lock nut 35. When the nut 35 has been thus released, the pins 31 should be reapplied to the holes 42 of the concave 17 and the latter may thereafter be rotated in either direction with the bars 40 so as to simultaneously move the crushing surface of the liner 18 and the nut 35 up or down depending upon the type of adjustment desired. After the concave 17 has been thus properly adjusted, the pins 41 should again be removed and the collar 34 should be rotated in the reverse direction to drive the ring nut 35 back into locking engagement at the surface 36 and to thereby clamp the screw threads 32, 33 to each other, and with the parts thus firmly clamped together the pins 41 may be restored to maintain the elements in the newly adjusted position until subsequent adjustment thereof becomes desirable. During such functioning of the adjusting mechanism, sealing rings 44, 45 will function to retain the screw threads 32, 33 and the lock nut 35 thoroughly concealed and protected the same as when the crusher is operating normally.

Referring particularly to Figs. 4, 5 and 6 of the drawings, the high speed gyratory crusher illustrated therein, comprises in general, a sturdy main frame 48 having a centrally bored upright central hub 49 and an annular outer wall 50 spaced from but rigidly secured to the hub; an eccentric sleeve 51 having an outer cylindrical surface journalled for rotation within the bore of the hub 49 and being suspended from a suitable thrust bearing while also being provided with an eccentric bore 52; an inner crushing member or head 53 having a depending central shaft 54 rigidly attached thereto and journalled for free rotation within the eccentric bore 52, the head being supported by the sleeve 51 and provided with a spherical zone shaped crushing mantle 55; a normally fixed annular outer crushing member or concave 56 surrounding the head 53 and having therein a tapered crushing liner 57 cooperating with the mantle 55 to form an annular downwardly extending and outwardly flaring crushing chamber 58; a coarse material supply hopper 59 carried by the concave 56 in open communication with the upper inlet end of the chamber 58 and cooperating with a gyratory plate 60 mounted upon the head 53 to feed raw material into the crusher; a concave support or ring 61 having an annular ridge 62 at its upper end cooperable with a tiltable peripheral flange 63 formed integral with the concave 56, the flange 63 and ridge 62 normally being held in contact with each other by a series of springs 64 interposed between the flange and an annular reaction plate 65 which is attached to the supporting ring 61 by tie bolts 66; and a power shaft 67 journalled in a tubular casing 68 mounted in the frame 48 and having a driving pulley 69 at one end thereof while its opposite end is provided with a bevel pinion 70 meshing with a bevel gear 71 rigidly secured to the lower end of the eccentric sleeve 51.

All of the foregoing structure of this modified type of crusher is also well known, and since the opposed crushing surfaces of the head mantle 55 and concave liner 57 of this machine are also subject to considerable wear, these elements are made readily removable from their supporting parts for renewal; and because these crushing surfaces also determine the size of the final product they must also be capable of ready relative adjustment both in order to compensate for excessive wear and to vary the desired size of the crushed material. In the modified crusher of Figs. 4, 5 and 6, such adjustment is made possible by providing external screw threads 72 on the stationary annular frame wall 50 and which coact with internal screw threads 73 formed within the supporting ring 61, and by also providing an annular series of teeth 74 on the exterior of the ring 61 with which a pawl 75 carried by a lever 76 is releasably cooperable, see Fig. 4. A ring nut 77 having thereon an external annular series of similar teeth 74', also has internal screw threads coacting with the external threads 72 of the frame wall 50, and is additionally provided with plane upper surfaces 78 adapted to contact the lower flat end faces of the ring 61. A second releasable pawl 79 such as shown in Fig. 5, and which is adapted to coact only with the teeth 74' of the ring nut 77 and is operable by means of another lever 80, may be provided in order to lock and to release the nut alone, but this pawl does not engage the teeth 74 of the frame wall 50.

The modified crusher of Figs. 4, 5 and 6 is also subject to dusty and gritty surroundings during normal use, and the adjusting screw threads 72, 73 and the lock nut 77 thereof should therefore also be thoroughly concealed and protected against foreign substances, at all times. In both Figs. 5 and 6, such concealment and protection is afforded at the inner ends of the threads by providing an annular depending rigid apron 82 on the concave support 61 adjacent to the outlet from the crushing chamber 58, and which is slidably cooperable with a resilient felt sealing ring 83 confined within an annular groove formed within the frame wall 50. The screw threads 72, 73 and lock nut 77 are thus constantly sealed against entry of foreign matter from within the crusher, by the ring 83 regardless of the position of the concave 56 relative to the head 53.

In the assemblage of Fig. 5, the outer ends of the screw threads 72, 73 are constantly sealed from the ambient atmosphere with the aid of a flexible sealing tube 84 the upper end of which is clamped to a metal ring 85 having angular transverse cross-section by means of an annular clamp 86, and the lower end of which is clamped to an external flange 87 on the frame wall 50 by means of an annular strap 88. The outwardly extending flange of the ring 85 is confined in sealing coaction with the nut 77 by a plate 89 so as to permit rotation of this lock nut relative to the non-rotary sealing tube 84. The tube 84 may be formed of any suitable flex-

ible material such as plastic or rubber composition which will permit it to collapse slightly and to expand as the nut 77 is moved down or up relative to the frame wall 50, while constantly maintaining a seal for concealing the threads 72, 73 from the ambient atmosphere.

In the modified assemblage of Fig. 6, the outer ends of the screw threads 72, 73 are likewise constantly sealed from the ambient atmosphere by means of a telescopic tube comprising an upper annular outer apron or section 90, a lower annular section 91, and an intermediate section 92 which is slidably but sealingly cooperable with the adjacent ends of the sections 90, 91. The upper extremity of the tube section 90 has an integral outwardly projecting flange 93 formed thereon and which is clamped to the ring nut 77 by a plate 94, while the lower extremity of the tube section 91 may be clamped to a flange 87 on the frame wall 50 by cap screws 95. The tube sections 90, 91, 92 may be formed of sheet metal or the like, and the medial section 92 constitutes a sealing ring or annular sliding seal between the apron section 90 and the frame section 91 which will permit the nut 77 to rotate and to move up or down relative to the frame wall 50 without destroying the sealing effect.

During normal operation of the modified crusher illustrated in Figs. 4, 5 and 6, power is applied from any desired source to the pulley 69 and shaft 67, thus transmitting rotary motion to the eccentric sleeve 51 through the pinion 70 and gear 71 and causing the eccentric to revolve within the bore of the frame hub 48 and to thereby gyrate the inner crushing member or head 53 relative to the outer crushing member or concave 56 while permitting free rotation of the head 53, mantle 55, and head shaft 54 about the central axis of the latter and relative to the eccentric sleeve 51. The material which is to be crushed may then be deposited within the hopper 59 and upon the gyrating feed plate 60 from which it drops by gravity into the upper inlet end of the crushing chamber 59. As the admitted material advances downwardly through the crushing zone between the head mantle 55 and the concave liner 57, it is gradually reduced and is eventually delivered from the lower outlet end of the chamber 59 and from the crusher through the annular space between the frame hub 49 and outer wall 50. If uncrushable material is admitted to the crushing chamber 59 while the crusher is operating, the springs 64 promptly function to permit the concave 56 to tilt upon its supporting ring 61 and to thus allow the abnormal material to pass through the crushing zone without damaging crusher parts, but the concave member 56 is normally stationary and does not move relative to the frame 48 unless adjustment thereof relative to the head member 53 becomes necessary.

When such adjustment is necessary, either because of excessive wear on the crushing surfaces of the mantle 55 and lever 57 or in order to vary the size of the final product, the ring nut 77 must first be released from locking position, and this may be accomplished by turning it slightly so as to break the clamping contact at the plane surfaces 78. The ring nut 77 may be thus retracted easily by utilizing the auxiliary pawl 79 and lever 80 shown in Fig. 5, while the main pawl 75 of Fig. 4 has been disengaged from the teeth 74, 74'; and after the nut 77 has been released, the pawl 75 may be applied to both sets of teeth 74, 74' and the auxiliary pawl 79 should be retracted

from the teeth 74'. By subsequently manipulating the main lever 76, both the concave support 61 and the ring nut 77 may be simultaneously rotated so as to move these elements up or down and to thereby vary the position of the concave liner 56 relative to the head mantle 55. When proper adjustment has been attained, the main pawl 75 may again be retracted, and the auxiliary pawl 79 may be utilized to again drive the nut 77 into locking or clamping coaction with the supporting ring 61 at the plane surfaces 78, whereupon the crusher is restored to normal operating condition. During the time such adjustment is being effected, the sealing ring 83 and the outer tubular seals function to maintain the screw threads 72, 73 constantly concealed and protected precisely as when the crusher is operating normally. In the embodiment of Fig. 5, the flexible tube 84 will collapse or stretch slightly while adjustment of the concave 56 is being effected but the opposite ends of this tube 84 will always remain sealed; whereas in the embodiment of Fig. 6 the telescoping rigid tube sections 90, 91, 92 will move axially relative to each other while concave adjustment is being effected but the upper and lower ends of all of these sections will always remain sealed.

From the foregoing detailed description it will be apparent that the present invention provides simple but effective means for adjusting and holding the concave member of a gyratory crusher, with the aid of coacting screw threads and a single lock nut, and for maintaining the adjusting threads thoroughly sealed against ingress of foreign matter at all times. The improved adjusting mechanisms may be conveniently manipulated to effect uniform clamping of the extensive screw threads all around the large crusher frames, and may be manufactured at moderate cost for use with various types of gyratory crushers. The use of the pins 41 as in Figs. 2 and 3 and of the auxiliary pawl 79 as in Fig. 5, for effecting release and re-locking of the thread clamping ring nut, is not essential and any other suitable means for effecting such release and locking movement of the nut may be utilized. However, in both cases the ring nut may be moved up or down simultaneously with the concave while adjustments of the latter are being made; and in both embodiments of the invention illustrated, the screw threads are constantly sealed from exposure to both the interior of the crusher and the ambient atmosphere.

It should be understood that it is not desired to limit this invention to the exact details of construction or to the precise mode of operation of the concave adjusting and sealing mechanisms herein shown and described, for various modifications within the scope of the appended claims may occur to persons skilled in the art.

I claim:

1. In a gyratory crusher, a frame, a crushing head mounted for gyration within said frame, a crushing concave carried by said frame and cooperating with said head to form an annular intervening crushing chamber, an inner annular apron carried by and depending from said concave around the outlet of said chamber, said frame and said concave having coacting external and internal screw threads therebetween for effecting adjustment of said concave relative to said head to vary the size of the crushed product delivered from said chamber, a ring nut movable along said external screw threads to clamp said concave in various positions of adjustment, an

outer annular apron rotatable with said nut while the latter is being advanced along the external threads, a sealing ring mounted upon said frame and coacting with said inner apron to constantly seal said screw threads from exposure to said chamber, and another sealing ring interposed between said outer apron and said frame externally of said screw threads.

2. In a gyratory crusher, a frame, a crushing head mounted for gyration within said frame, a crushing concave having a support carried by said frame and cooperating with said head to form an annular intervening crushing chamber, an inner annular apron carried by and depending from said concave around the outlet of said chamber, said support and said concave having coacting external and internal screw threads therebetween for effecting adjustment of said concave relative to said head to vary the size of the crushed product delivered from said chamber, a ring nut movable along said external screw threads and being engageable with said support to clamp said concave in various positions of adjustment, an outer annular apron rotatable with said nut while the latter is being advanced along the external threads, an annular internal seal interposed between said inner apron and said support, and an annular external seal interposed between said outer apron and said concave.

3. In a gyratory crusher, a frame, a crushing head mounted for gyration within said frame, a crushing concave having a support carried by said frame and cooperating with said head to form an annular intervening crushing chamber, an inner annular apron carried by said support and surrounding the outlet of said chamber, said frame and said support having coacting external and internal screw threads for effecting adjustment of said concave relative to said head to vary the size of the crushed product delivered from said chamber, a ring nut movable along said external screw threads and being engageable

with said support to clamp said concave in various positions of adjustment, an outer annular apron rotatable with said nut while the latter is being advanced along the external threads, a sealing ring mounted upon said frame and coacting with said inner apron, and an annular seal interposed between said outer apron and said frame.

4. In a gyratory crusher, a frame, a crushing head mounted for gyration within said frame, a crushing concave carried by said frame and cooperating with said head to form an annular intervening crushing chamber, an inner annular apron carried by and depending from said concave around the outlet of said chamber, said frame and said concave having coacting external and internal screw threads respectively therebetween for effecting adjustment of the concave relative to said head to vary the size of the crushed product delivered from said chamber, a ring nut movable along said external screw threads and being cooperable with said internal screw threads to clamp said concave in various positions of adjustment, an outer annular apron movable with said nut while the latter is being advanced along said external screw threads, a sealing ring interposed between said inner apron and said frame to constantly seal said screw threads from exposure to said chamber, and an annular external seal interposed between said outer apron and said frame to constantly seal said screw threads from exposure to the ambient atmosphere.

HARVEY H. RUMPEL.

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